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Physics 30
Aug. 1969

HIGH SCHOOL AND UNIVERSITY MATRICULATION
EXAMINATIONS BOARD

DEPARTMENTAL EXAMINATIONS, 1969
AUGUST

PHYSICS 30

Time — 2 hours.

DO NOT SPEND TOO MUCH TIME ON ANY ONE QUESTION.
READ THE PAPER CAREFULLY.

Total Possible Mark — 82.

Questions 1 to 41 are multiple choice questions, valued at 2 marks each.

DO NOT SPEND TOO MUCH TIME ON ANY ONE QUESTION. THE QUESTIONS ARE ARRANGED IN APPROXIMATE ORDER OF INCREASING DIFFICULTY. YOU SHOULD ALLOW MORE TIME FOR THE QUESTIONS NEAR THE END OF THE TEST. Mathematical tables, slide rules and geometry sets may be used.

To ensure accuracy in the handling of your examination papers, the following sections on your ANSWER SHEET MUST BE COMPLETED.

SECTION A — Supply information as requested.

SECTION B — Labels will not be provided for the August examinations. Therefore disregard the box re label.

Indicate your name, mailing address and birth date in the space provided.

SECTION C — Supply information as requested.

SECTION D — Disregard this section.

CONSTANTS

$g = 9.8$ m/sec^2
$= 32$ ft/sec^2
1 hp = 550 ft lb/sec
= 746 watts
$c = 3.0 \times 10^8$ m/sec
$u = 1.66 \times 10^{-27}$ kg
charge on the electron $= 1.6 \times 10^{-19}$ C
mass of the electron $= 9.1 \times 10^{-31}$ kg
1 yd = 0.9144 m exactly

DO NOT FOLD EITHER THE ANSWER SHEET OR TEST BOOKLET.

Your presiding examiner will collect the answer sheet and booklet separately for transmission to the Department.

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CURR HIST

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QUAECUMQUE VERA

This examination consists of 41 questions with a value of two marks each. All questions should be attempted in order to constitute a full paper. In each case select the BEST of the four answers and record your choice on the separate answer sheet provided.

EXAMPLE	ANSWERS	ANSWER SHEET
If you drive 180 mi north in a time of 3.0 hr, what is your average velocity?	A. 40 mph north B. 60 mph north C. 30 mph north D. 80 mph north	A ☐ B ■ C ☐ D ☐ E ☐ DISREGARD COLUMN "E" ON ANSWER SHEET

You are to use an ORDINARY HB PENCIL to mark your answers on the separate answer sheet. Make certain your answer marks are heavy and black. If you change your mind about an answer, be sure to erase your first mark completely. There should be only one answer marked for each question. Be sure there are no stray pencil marks on your answer sheet.

1. All four men listed on the right contributed to our scientific knowledge. The chronological order of the men and their great scientific contributions is

1.
A. Coulomb, Newton, Faraday, Bohr
B. Newton, Coulomb, Bohr, Faraday
C. Newton, Faraday, Coulomb, Bohr
D. Newton, Coulomb, Kirchhoff, Bohr

2. Which of the following is NOT a vector quantity?

2.
A. pressure
B. weight
C. mass
D. momentum

3. A canoeist can paddle in still water at a rate of 6.0 mph. If a river flows at 3.0 mph, in what direction must he head to cross the river the shortest possible time?

3.
A. 27° downstream
B. 27° upstream
C. 30° upstream
D. straight across

4. The approximate numbers 4.8, 11.3, 0.15, 16.417, and 398 were added. The correct number of significant digits in the final answer is

4.
A. 2
B. 3
C. 4
D. 5

5. A skier wishes to decrease friction as much as possible. If the hill is perfectly uniform and inclined at 15°, which of the following would most likely reduce friction?

5.
A. decreasing his total weight on the skis
B. decreasing the area of the skis in contact with the snow
C. decreasing the weight of the skis
D. increasing the length of the skis

6. Which of the following laws could best be described as empirical?

6.
A. Newton's law of universal gravitation
B. Coulomb's law of electrostatic force between point charges
C. Newton's second law of motion
D. the laws of friction

[OVER]

ROUGH WORK ONLY

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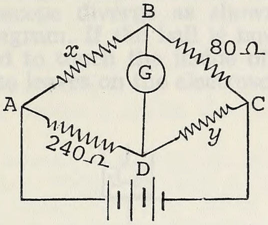
7. A Wheatstone bridge is set up as shown with a sensitive galvanometer G connecting B and D. If G reads zero, which of the following proportions is NOT correct?



7. A. $\frac{x}{80} = \frac{240}{y}$

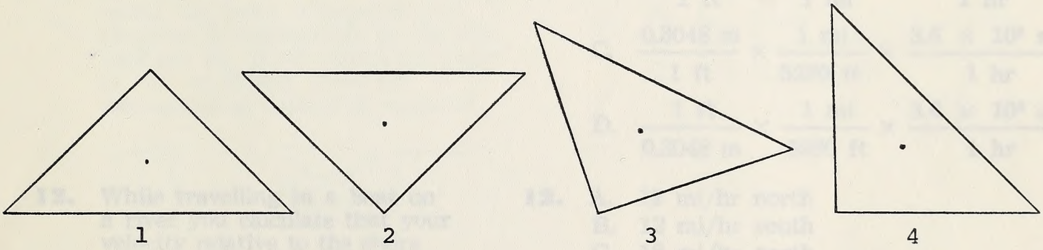
B. $\frac{y}{240} = \frac{80}{x}$

C. $\frac{x}{80} = \frac{y}{240}$

D. $\frac{y}{80} = \frac{240}{x}$

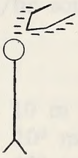
8. Four identical 45° – 45° – 90° triangles are photographed on a horizontal surface as shown. The center of gravity of each triangle is marked with a dot. If the stability in the vertical plane is considered the arrangement from most stable to least stable is:

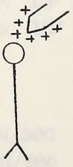
8. A. 1, 4, 3, 2
B. 4, 1, 2, 3
C. 4, 1, 3, 2
D. 1, 4, 2, 3



9. Which of the diagrams best illustrates part of the procedure in giving an electroscope a positive induced charge that will remain after the rod is removed?

9.

A.


B.


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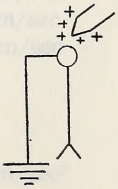

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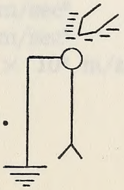
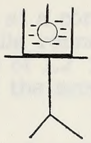


ROUGH WORK ONLY

(No marks given for work in this space)

10. A negatively charged steel ball is suspended by a string inside an aluminum can placed on an electroscope. The leaves of the electroscope diverge as shown in the diagram. If the ball is now allowed to touch the inside of the can, the leaves on the electroscope will



10.
- A. collapse completely
- B. collapse a small amount
- C. remain unchanged
- D. diverge further

11. To convert 1.0 m/sec to mi/hr you multiply

11.
- A. $\frac{0.9144\ \text{m}}{1\ \text{ft}} \times \frac{1\ \text{mi}}{5280\ \text{ft}} \times \frac{3.6 \times 10^3\ \text{sec}}{1\ \text{hr}}$
- B. $\frac{0.3048\ \text{m}}{1\ \text{ft}} \times \frac{5280\ \text{ft}}{1\ \text{mi}} \times \frac{3.6 \times 10^3\ \text{sec}}{1\ \text{hr}}$
- C. $\frac{0.3048\ \text{m}}{1\ \text{ft}} \times \frac{1\ \text{mi}}{5280\ \text{ft}} \times \frac{3.6 \times 10^3\ \text{sec}}{1\ \text{hr}}$
- D. $\frac{1\ \text{ft}}{0.3048\ \text{m}} \times \frac{1\ \text{mi}}{5280\ \text{ft}} \times \frac{3.6 \times 10^3\ \text{sec}}{1\ \text{hr}}$

12. While travelling in a boat on a river you calculate that your velocity relative to the shore is 15 mi/hr north. A log floating on the river in front of you to be travelling towards you at 3 mi/hr. The velocity of the river must be

12.
- A. 12 mi/hr north
- B. 12 mi/hr south
- C. 18 mi/hr north
- D. 18 mi/hr south

13. An arrow is shot into the air so that its vertical velocity is 58.8 m/sec and its horizontal velocity is 19.6 m/sec. Neglecting friction, how far will it travel horizontally before it hits the ground?

13.
- A. 5.9×10 m
- B. 2.4×10^2 m
- C. 1.2×10^2 m
- D. 2.5×10^2 m

14. A freight car of mass 1.0×10^4 kg is coasting along the track at 2.0 m/sec. A second freight car of 2.0×10^4 kg mass comes toward it in the opposite direction. If both cars come to rest upon collision, how fast was the second car moving?

14.
- A. 1.0 m/sec
- B. 2.0 m/sec
- C. 2.8 m/sec
- D. 4.0 m/sec

15. With what acceleration would a mass of 100 kg fall on a planet with a mass 300 times that of the earth and a radius 10 times that of the earth?

15.
- A. 3.3 m/sec^2
- B. 9.8 m/sec^2
- C. 29 m/sec^2
- D. 2.9×10^2 m/sec^2

ROUGH WORK ONLY

(No marks given for work in this space)

16. A mass on a string is suspended 16 ft above the floor. The mass is pulled back, keeping the string taut, until it is raised a vertical distance of 4.0 ft. It is released and the string breaks just as the mass gets to its lowest point. What horizontal distance will the mass travel after the string breaks, before it strikes the floor?

16.
A. zero
B. 8.0 ft
C. 16 ft
D. 32 ft

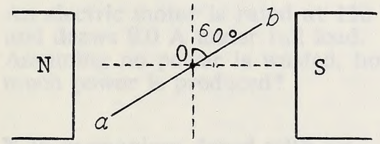
17. A car travels at a constant speed of 88 ft/sec while rounding a curve with a radius of 1.2×10^3 ft. The magnitude of the acceleration is

17.
A. 0.073 ft/sec^2
B. 6.4 ft/sec^2
C. 19 ft/sec^2
D. 22 ft/sec^2

18. With what speed must a 176 lb man run up a 30° slope in order to develop 1.0 hp?

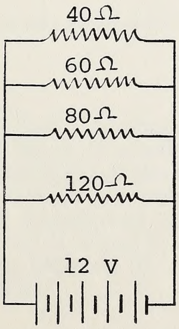
18.
A. 6.2 ft/sec
B. 4.6 ft/sec
C. 3.1 ft/sec
D. 9.4 ft/sec

19. An end view of a wire loop turning about the point 0 between two magnets is represented by the line segment ab. If ab makes an angle of 60° as shown, then the instantaneous current is equal to



19.
A. I_{max} sin 60°
B. I_{max} cos 60°
C. 0.71 I_{max} cos 60°
D. 0.71 I_{max} sin 60°

20. Resistances of 40 ohms, 60 ohms, 80 ohms and 1.2×10^2 ohms are placed in parallel and connected to a 12V power supply as shown. The energy loss is greatest in the resistance of

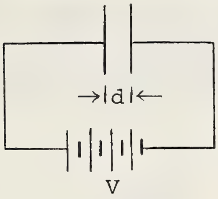


20.
A. 40 ohms
B. 60 ohms
C. 80 ohms
D. 1.2×10^2 ohms

ROUGH WORK ONLY

(No marks given for work in this space)

21. In the figure below the two parallel plates separated by a distance d in air, are connected to a battery of potential V. Which of the following procedures will NOT increase the capacitance?



21.
A. increasing the area of parallel plates
B. decreasing d
C. increasing V
D. using glass between the plates

22. A 220 V electric motor with an internal resistance of 4.0 ohms draws a current of 12 A. What is the back emf?

22.
A. 268 V
B. zero
C. 48 V
D. 172 V

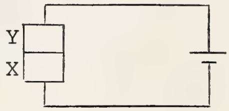
23. In the mass spectroscope, isotopes of an element can be separated utilizing the fact that each

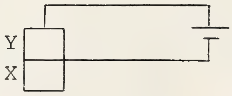
23.
A. travel at a different velocity
B. has a different charge
C. has a different mass
D. has a different mass and velocity

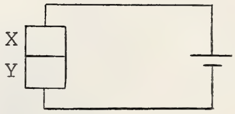
24. An electric motor is rated at 110 V and draws 8.0 A under full load. Assuming no power is wasted, how much power is produced?

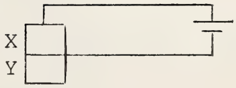
24.
A. 1.2 hp
B. 0.85 hp
C. 1.6 hp
D. 0.28 hp

25. X is germanium doped with an element containing 5 outer electrons. Y is germanium doped with an element containing 3 outer electrons. Which of the four circuits is "biased"?

25.
A.


B.


C.


D.


26. A cart, released from rest at the top of an inclined plane covers 1.6 cm in the first unit of time, 4.8 cm in the second unit of time, 8.0 cm in the third unit of time, and 11.2 cm in the fourth unit of time. The acceleration down the plane would be:

26.
A. 0.028 m/(time unit)^2
B. 0.064 m/(time unit)^2
C. 0.016 m/(time unit)^2
D. 0.032 m/(time unit)^2

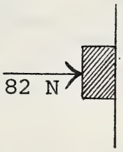
ROUGH WORK ONLY

(No marks given for work in this space)

27. A stone is dropped from a balloon ascending with a vertical velocity of 4.9 m/sec. If the stone reaches the ground in 10 seconds, find the height of the balloon when the stone was released neglecting friction.

27.
A. 4.9×10^2 m
B. 5.4×10^2 m
C. 4.4×10^2 m
D. 9.3×10^2 m

28. A wooden block of mass 2.4 kg is held against a vertical wall by a horizontal force of 82 N. Calculate the acceleration of the block down the wall if the coefficient of friction is 0.25.

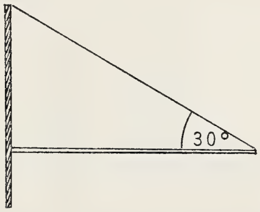


28.
A. 1.1 m/sec^2
B. 1.2 m/sec^2
C. 4.9 m/sec^2
D. 3.7 m/sec^2

29. A car weighing 2000 lb travels up a 30° incline. What minimum power is required to give the car a steady speed of 44 ft/sec? Neglect friction.

29.
A. 80 hp
B. 1.4×10^2 hp
C. 1.6×10^2 hp
D. 2.8×10^2 hp

30. A uniform horizontal beam 8.0 ft long and weighing 84 lb is hinged to a wall and supported by a light chain at the other end. The chain makes an angle of 30° with the beam. If the chain can exert a maximum force of 200 lb how far along the beam from the wall could a 75 lb weight be placed without breaking the chain?



30.
A. 7.7 ft
B. 2.3 ft
C. 8.7 ft
D. 6.2 ft

31. A 10 kg ball travelling 4.0 m/sec strikes a block of wood resting on a table. If the mass of the block of wood is 40 kg and 80 per cent of the ball's energy is transferred to the block, how far will it travel if the coefficient of friction between the block and the table is 0.25?

31.
A. 0.17 m
B. 0.65 m
C. 0.40 m
D. 6.4 m

32. A man pulls horizontally on a 10 kg mass initially at rest on the rough floor. He exerts a force of 10 N and the mass moves through a distance of 6.0 m. The mass has then acquired a velocity of 3.0 m/sec. The final kinetic energy of the mass is

32.
A. 7.5 J
B. 15 J
C. 45 J
D. 60 J

ROUGH WORK ONLY

(No marks given for work in this space)

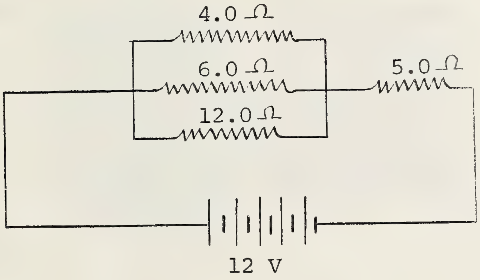
33. The effective or root-mean-square value of an AC voltage supply is 24 V. It is connected to two resistances of 10 ohms and 15 ohms connected in parallel. The maximum instantaneous current drawn from the supply is

33. A. 2.8 A
B. 3.4 A
C. 4.0 A
D. 5.7 A

34. A charge of 6.0×10^{-6} is travelling at right angles to a magnetic field of 2.5×10^{-1} T with a speed of 0.15 m/sec. The force of the charge is

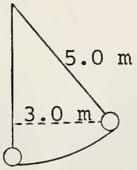
34. A. 2.2×10^{-5} N
B. 1.1×10^{-7} N
C. 1.9×10^{-7} N
D. 2.2×10^{-7} N

35. A 12 V battery is connected to a circuit as shown in the diagram. If the internal resistance of the battery is 1.0 ohm, what current flows through the 6.0 ohm resistor?



35. A. 0.15 A
B. 0.50 A
C. 1.5 A
D. 1.8 A

36. A 6.0 kg ball hangs on a 5.0 m string. It is swung aside until the horizontal component of its displacement is 3.0 m. How much work is done in this process?



36. A. 30 J
B. 59 J
C. 1.8×10^{2} J
D. 2.4×10^{2} J

37. The kinetic energy of an alpha particle (4.0 u) travelling 10^{-2} c compared to the kinetic energy of a neutron (1.0 u) travelling 10^{-1} c is

37. A. $\frac{4.0 \times 10^{-2}}{1.0}$
B. $\frac{4.0 \times 10^{-1}}{1.0}$
C. $\frac{4.0 \times 10^{2}}{1.0}$
D. $\frac{40}{1.0}$

ROUGH WORK ONLY

(No marks given for work in this space)

38. Electric kettles are rated according to the supply voltage and resistance of their heaters. A 120 V 40 ohm kettle contains 200 g of water at 20° C. A second kettle rated at 120 V 30 ohms, contains 400 g of water at 20° C. The time required for the first kettle to bring its water to a boil compared to the time for the second is

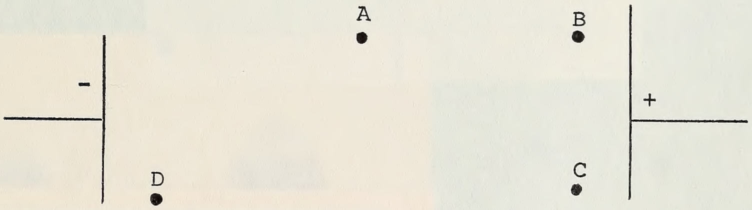
38. A. $\frac{1}{1}$
B. $\frac{3}{8}$
C. $\frac{3}{2}$
D. $\frac{2}{3}$

39. What is the acceleration of an electron in an electric field with a strength of 6.0 N/C?

39. A. 9.5×10^{-13} m/sec^2
B. 9.8×10^{12} m/sec^2
C. 9.3×10^{-12} m/sec^2
D. 1.1×10^{12} m/sec^2

40. A uniform electric field exists between the plates shown in the diagram. An electron at rest at A is accelerated by the field to B where the difference in potential between A and B is 10 V. Similarly 50 protons at rest at C are accelerated to D where the difference in potential is 20 V. The kinetic energy of the electron at B compared to the protons at D is

40. A. $\frac{1}{10}$
B. $\frac{1}{100}$
C. $\frac{10}{1}$
D. $\frac{100}{1}$



41. An electron is accelerated through an electric field whose potential difference is 4.0×10^4 V. Calculate the speed of electron assuming the mass remains constant.

41. A. 3.8×10^7 m/sec
B. 8.4×10^7 m/sec
C. 1.2×10^8 m/sec
D. 3.7×10^8 m/sec

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